



# New Frontiers Preproposal Conference

## June 3, 2009

Thomas Morgan, New Frontiers Program Scientist  
Planetary Science Division  
Science Mission Division  
NASA Headquarters

Contact information: [thomas.h.morgan@nasa.gov](mailto:thomas.h.morgan@nasa.gov)  
202-358-0828

*But I tell you the New Frontier is here, ... the uncharted areas of science and space... JFK*



# What is the New Frontiers Program?



- Developed by NASA to pursue a clear set of goals and science priorities, with PI-led missions selected through a competitive process.
  - Limited to missions ranked highly by the Decadal Survey, as amplified by “Opening New Frontiers in Space” document;
  - Fitting within the medium mission category; and
  - With a goal of one new mission every 52 Months.
- Two-step selection process
  - Up to three investigations will be selected for Phase A concept studies;
  - Only one investigation will be continued into Phase B.
- This specific opportunity (NF-3) does **not** permit the use of Radioisotope Power Sources (RPSs).
  - However, small radioactive sources (*e.g.*, RHUs and calibration sources) may be proposed
- Mission of Opportunity (MoO) investigations are **not** part of this Opportunity.

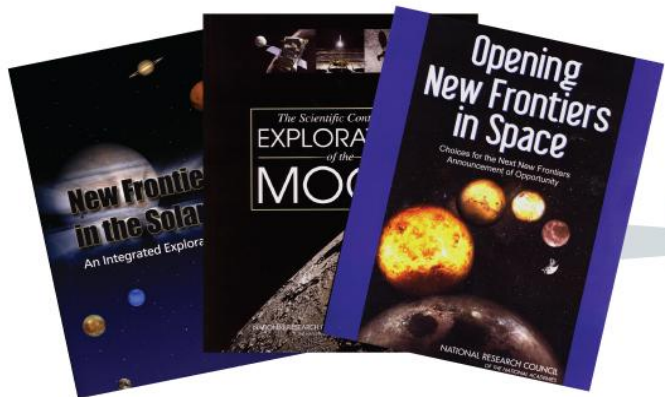


# What is New Frontiers?--II



The New Frontiers Program is **science-driven**, and is focused on characterizing and understanding **solar system bodies** (excluding Earth and Sun) in order to illuminate the origin, evolution, and current state of the solar system. The objectives of New Frontiers are:

- **Advancement in scientific knowledge** and exploration of the elements of our solar system and other planetary systems;
- **Addition of scientific data**, including maps, returned samples, and other products to archives accessible to all scientists;
- Promulgation of **scientific advancements** and results in peer-reviewed literature, popular media, scholastic curricula, and other educational materials that can be used to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics;
- **Expansion of the pool** of well-qualified Principal Investigators and Program Managers for implementation of future missions in Discovery and other programs, through current involvement as Co-Investigators and other team members; and
- **Implementation of technology** advancements that have been proven in related programs.



**Decadal Survey**  
and Significant follow-on Reports

**NASA  
Strategic and  
Budget Planning  
Process**

Flagship Mission

New Frontiers

Discovery

Lunar Robotic

Mars Robotic

Human Exploration



# New Frontiers Program



1<sup>st</sup> NF mission  
New Horizons:

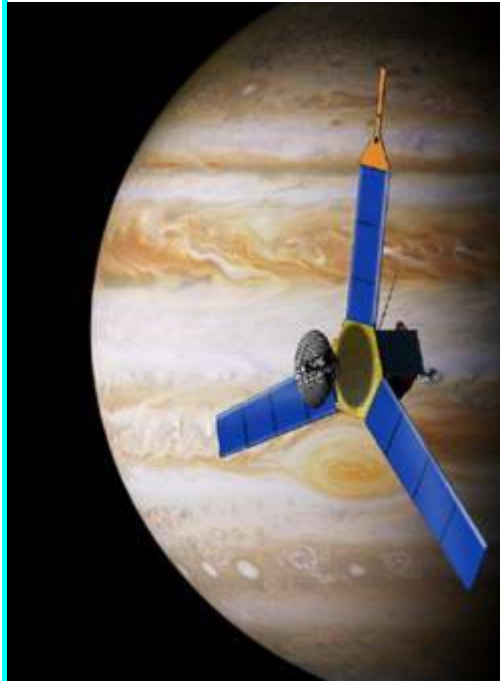
**Pluto-Kuiper Belt  
Mission**



Launched January **2006**  
Arrives July 2015

2<sup>nd</sup> NF mission  
JUNO:

**Jupiter Polar Orbiter  
Mission**



August **2011** launch

3<sup>rd</sup> NF mission opportunity

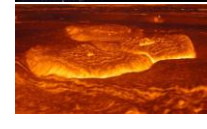
South Pole  
Aitken Basin Sample  
Return



Comet Surface  
Sample Return (CSSR)



Venus In Situ  
Explorer (VISE)



Network Mars Science



Trojan/Centaur



Asteroid Sample Return



Io Observer

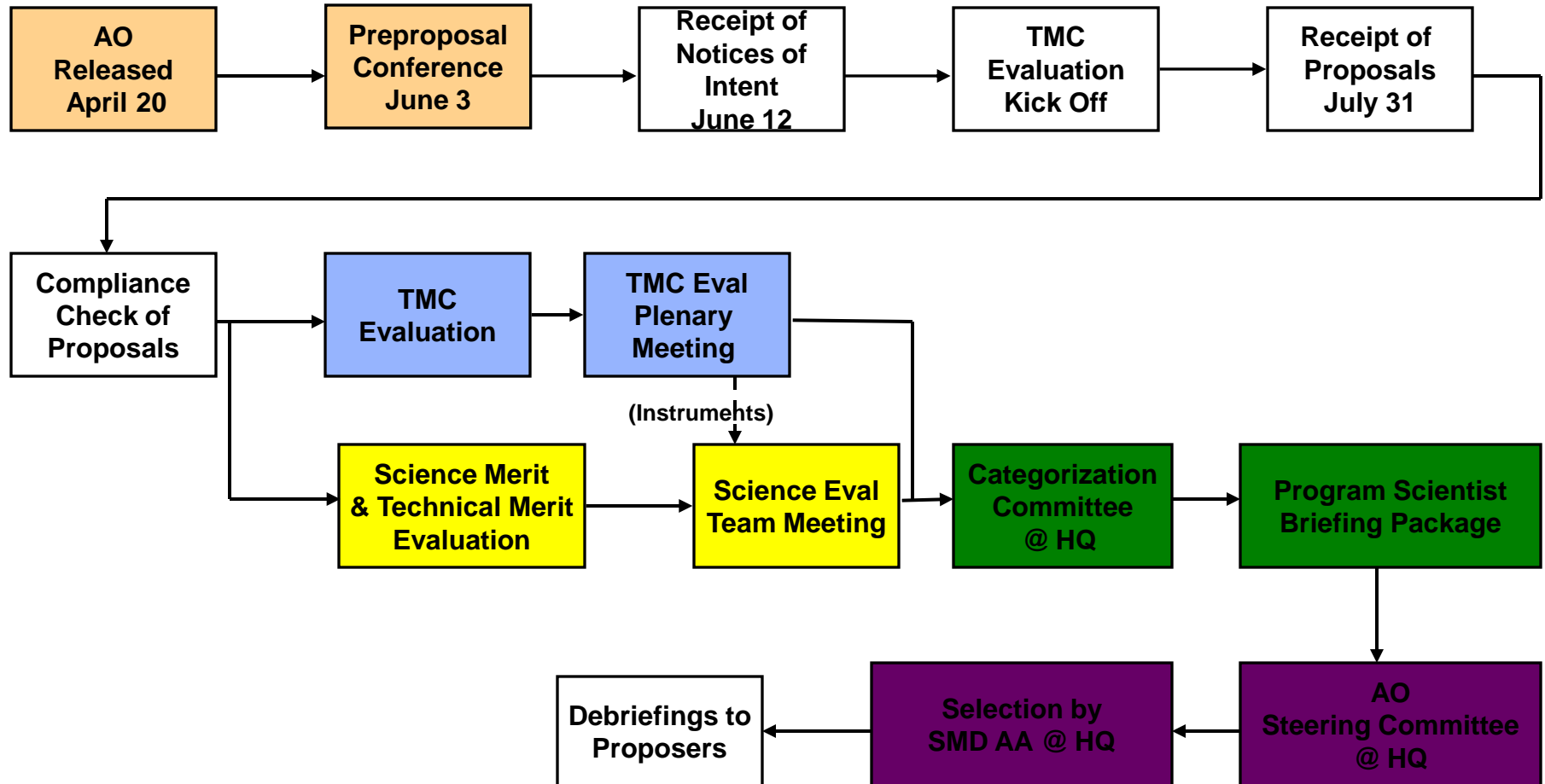


Ganymede Observer



**Launch 2016-2018**

# New Frontiers Proposal Evaluation Process





# New Frontiers Missions Requirements



- Proposals shall describe a science investigation that addresses a **preponderance** of the science objectives or science questions for any one of the eight mission concepts described in the following Charts.
- Proposals shall clearly **justify the choice of science objectives** that the proposed science investigation and mission can address; among other rationales, the choice of science objectives shall be justified in terms of science return for a New Frontiers class mission.



# *South Pole – Aitken Basin Sample Return*



- Determine the chronology of basin-forming impacts and constrain the period of late, heavy bombardment in the inner solar system, and thus, address fundamental questions of inner solar system impact processes and chronology;
- Elucidate the nature of the Moon's lower crust and mantle by direct measurements of its composition and of sample ages;
- Characterize a large lunar impact basin through "ground truth" validation of global, regional, and local remotely sensed data of the sampled site;
- Elucidate the sources of thorium and other heat-producing elements in order to understand lunar differentiation and thermal evolution; and
- Determine ages and compositions of far-side basalts to determine how mantle source regions on the far side of the Moon differ from regions sampled by Apollo and Luna basalts

Any sample return mission architecture that achieves the preponderance of the science objectives stated above for a cost within the New Frontiers cost cap will be considered responsive to this AO.





# *Venus In Situ Explorer*



- Understand the physics and chemistry of Venus' atmosphere through measurement of its composition, especially the abundances of its trace gases, sulfur, light stable isotopes, and noble gas isotopes;
- Constrain the coupling of thermochemical, photochemical and dynamical processes in Venus' atmosphere and between the surface and atmosphere to understand radiative balance, climate, dynamics, and chemical cycles;
- Understand the physics and chemistry of Venus' crust;
- Understand the properties of Venus' atmosphere down to the surface through meteorological measurements and improve our understanding of Venus' zonal cloud-level winds;
- Understand the weathering environment of the crust of Venus in the context of the dynamics of the atmosphere of Venus and the composition and texture of its surface materials; and
- Look for planetary scale evidence of past hydrological cycles, oceans, and life and constraints on the evolution of Venus' atmosphere.

Any mission architecture that achieves the preponderance of the science objectives stated above for a cost within the New Frontiers cost cap will be considered responsive to this AO.



# *Comet Surface Sample Return*



- Identify the elemental, isotopic, organic, and mineralogical composition of cometary materials;
- Understand how cometary activity is driven;
- Understand how small bodies accrete;
- Determine the scales of physical and compositional heterogeneity;
- Understand how the particles on a cometary nucleus are bound together; and
- Determine the macroscopic mineralogical and crystalline structure and isotopic ratios in cometary solids.

The choice of target comet is left to the proposer; however that choice of target must be justified by how well it supports attaining the above science objectives. The volume (or mass) of the sample returned and the temperature at which the sample is maintained during passage to Earth are not specified, but proposals must demonstrate that both the size and condition of the sample are sufficient to achieve a preponderance of the science objectives stated above.

Any sample return mission architecture that achieves the preponderance of the science objectives stated above for a cost within the New Frontiers cost cap will be considered responsive to this AO.



# Network Science



- Determination of the planet's internal structure, including its core; the elucidation of surface and near-surface composition as well as thermal and mechanical properties;
- Extensive synoptic measurements of the atmosphere and weather; and
- Atmospheric gas isotopic observations (to constrain the size of currently active volatile reservoirs) and measurements of subsurface oxidizing properties and surface-atmosphere volatile exchange processes would be valuable.

The interiors of Mercury, Venus, and Mars are poorly characterized and geophysical network missions to these bodies are needed to learn what is inside them. A geophysical network can also be supplemented with measurement of planetary heat flow, magnetic field, atmospheric properties and winds, climate variations, surface-atmosphere interactions, and surface mechanical and thermal properties. A variety of developments since the decadal survey, when combined with the strong initial rationale, elevate this mission concept into consideration for all terrestrial planets, except Earth, and specifically excluding the Moon.

Any mission architecture that achieves the preponderance of the science objectives stated above for the planets Mars and Venus, or that accomplishes the first Science Objective above (Determination of the planet's internal structure...) for the planet Mercury, at a cost within the New Frontiers cost cap, will be considered responsive to this AO.



# *Trojan/Centaur Reconnaissance*



- Determine the physical properties (e.g., mass, size, density) of a Trojan and/or a Centaur; and
- Map the color, albedo, and surface geology of a Trojan and/or a Centaur at a resolution sufficient to distinguish important features for deciphering the history of the object (e.g., craters, fractures, lithologic units).

Since the original mission concept contained in the NOSSE report included examination of both a Trojan and a Centaur, proposers considering a mission directed at only a Trojan or a Centaur should explicitly justify the choice in terms of science return for a New Frontiers class mission.

Proposals for this concept must justify the choice of target by how well it supports achieving a preponderance of the science objectives stated above. Any mission architecture that achieves a preponderance of the science objectives stated above for a cost within the New Frontiers cost cap will be considered responsive to this AO.



# *Asteroid Rover/Sample Return*



- Map the surface texture, spectral properties (e.g., color, albedo) and geochemistry of the surface of an asteroid at sufficient spatial resolution to resolve geological features (e.g., craters, fractures, lithologic units) necessary to decipher the geologic history of the asteroid and provide context for returned samples;
- Document the regolith at the sampling site in situ with emphasis on, e.g., lateral and vertical textural, mineralogical and geochemical heterogeneity at scales down to the sub-millimeter; and
- Return a sample to Earth in amount sufficient for molecular (or organic) and mineralogical analyses, including documentation of possible sources of contamination throughout the collection, return and curation phases of the mission.

Proposals for this concept must justify the choice of target by how well it supports attaining the above science objectives.

While the term “Rover” has been preserved in the title to retain a linkage to the findings of the NOSSE report, NASA does not require proposers to use a rover. Any sample return mission architecture that achieves the preponderance of the science objectives stated above for a cost within the New Frontiers cost cap will be considered responsive to this AO.



# *Io Observer*



- Determine the magnitude, spatial distribution, temporal variability, and dissipation mechanisms of Io's tidal heating.
- Determine Io's interior structure, e.g., does it have a magma ocean
- Determine whether Io has a magnetic field.
- Understand the eruption mechanisms for Io's lavas and plumes and their implications for volcanic processes on Earth, especially early in Earth's history when its heat flow was similar to Io's, and elsewhere in the solar system.
- Investigate the processes that form Io's mountains and the implications for tectonics under high-heat-flow conditions that may have existed early in the history of other planets.
- Understand Io's surface chemistry, volatile and silicate, and derive magma compositions (and ranges thereof), crustal and mantle compositions and implications for the extent of differentiation, and contributions to the atmosphere, magnetosphere and torus.
- Understand the composition, structure, and thermal structure of Io's atmosphere and ionosphere, the dominant mechanisms of mass loss, and the connection to Io's volcanism.

Any mission architecture that achieves the preponderance of the science objectives stated above for a cost within the New Frontiers cost cap will be considered responsive to this AO.



# *Ganymede Observer*



- Understand Ganymede's intrinsic and induced magnetic fields and how they're generated, and characterize their interaction with Jupiter's magnetic field.
- Determine Ganymede's internal structure, especially the depths to and sizes or thicknesses of the probable metallic core and deep liquid water ocean, and the implications for current and past tidal heating and the evolution of the Galilean satellite system as well as ocean chemistry.
- Understand Ganymede's endogenic geologic processes, e.g., the extent and role(s) of cryovolcanism, the driving mechanism for the formation of the younger, grooved terrain, and the extent to which Ganymede's tectonic processes are analogs for tectonics on other planetary bodies (both icy and silicate).
- Document the non-ice materials on Ganymede's surface and characterize in detail the connection between Ganymede's magnetosphere and its surface composition (e.g., polar caps).
- Document the composition and structure of the atmosphere, identifying the sources and sinks of the atmospheric components and the extent of variability (spatial and/or temporal).

Any mission architecture that achieves the preponderance of the science objectives stated above for a cost within the New Frontiers cost cap will be considered responsive to this AO.



# *Scientific Merit of the Proposed Investigation*



The information provided in a proposal will be used to assess the intrinsic scientific merit of the proposed investigation. Scientific merit will be evaluated for the Baseline Science Mission and the Threshold Science Mission; science enhancements options beyond the Baseline Science Mission will not contribute to the assessment of the scientific merit of the proposed investigation. The factors for scientific merit include the following:

**Factor A-1. Compelling nature and scientific priority of the proposed investigation's science goals and objectives.** This factor includes the clarity of the goals and objectives; how well the goals and objectives reflect program, Agency, and National priorities; the potential scientific impact of the investigation on program, Agency, and National science objectives; and the potential for fundamental progress, as well as filling gaps in our knowledge relative to the current state of the art.

**Factor A-2. Programmatic value of the proposed investigation.** This factor includes the unique value of the investigation to make scientific progress in the context of other ongoing and planned missions; the relationship to the other elements of NASA's science programs; how well the investigation may synergistically support ongoing or planned missions by NASA and other agencies; and the necessity for a space mission to realize the goals and objectives.





# *Scientific Merit of the Proposed Investigation*



Factors continued

Factor A-3. Likelihood of scientific success. This factor includes how well the anticipated measurements support the goals and objectives; the adequacy of the anticipated data to complete the investigation and meet the goals and objectives; and the appropriateness of the mission requirements for guiding development and ensuring scientific success.

Factor A-4. Scientific value of the Threshold Science Mission. This factor includes the scientific value of the Threshold Science Mission using the standards in the first factor of this section and whether that value is sufficient to justify the proposed cost of the mission.

Factors A-1 through A-3 are evaluated for the Baseline Science Mission assuming it is implemented as proposed and achieves technical success. Factor A-4 is similarly evaluated for the Threshold Science Mission.



# *Scientific Implementation Merit and Feasibility*



The information provided in a proposal will be used to assess merit of the plan for completing the proposed investigation including the scientific implementation merit, feasibility, resiliency, and probability of scientific success of the proposed investigation. The factors for scientific implementation merit and feasibility include the following:

**Factor B-1. Merit of the instruments and mission design for addressing the science goals and objectives.** This factor includes the degree to which the proposed mission will address the goals and objectives; the appropriateness of the selected instruments and mission design for addressing the goals and objectives; the degree to which the proposed instruments and mission can provide the necessary data; and the sufficiency of the data gathered to complete the scientific investigation.

**Factor B-2. Probability of technical success.** This factor includes the maturity and technical readiness of the instruments; the adequacy of the plan to develop the instruments within the proposed cost and schedule; the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks; the likelihood of success in developing any new technology that represents an untested advance in the state of the art; the ability of the development team - both institutions and individuals - to successfully implement those plans; and the likelihood of success for both the development and the operation of the instruments within the mission design.



# *Scientific Implementation Merit and Feasibility*



Factors continued

Factor B-3. Merit of the data analysis plan. This factor includes the merit of plans for data analysis and data archiving to meet the goals and objectives, to result in the publication of science discoveries in the professional literature, and to leave a data archive of value to the science community. Considerations in this factor include an assessment of planning and budget adequacy and evidence of plans for well-documented, high-level products and software usable to the entire science community, consideration of adequate resources for physical interpretation of data and reporting scientific results in refereed journals, and assessment of the proposed plan for the timely release of the data to the public domain for enlarging its science impact.

Factor B-4. Science resiliency. This factor includes both developmental and operational resiliency. Developmental resiliency includes the approach to descoping the Baseline Science Mission to the Threshold Science Mission in the event that development problems force reductions in scope. Operational resiliency includes the ability to withstand adverse circumstances, the capability to degrade gracefully, and the potential to recover from anomalies in flight.



# *Scientific Implementation Merit and Feasibility*



Factors continued

**Factor B-5. Probability of science team success.** This factor will be evaluated by assessing the experience, expertise, and organizational structure of the science team and the mission design in light of any proposed instruments. The role of each Co-Investigator will be evaluated for necessary contributions to the proposed investigation; the inclusion of Co-Is who do not have a well defined role may be cause for downgrading of the proposal.

**Factor B-6. Merit of any science enhancement options (SEOs), if proposed.** This factor includes assessing the appropriateness of activities selected to enlarge the science impact of the mission; the potential of the selected activities to enlarge the science impact of the mission; and the appropriate costing of the selected activities. The peer review panel will inform NASA whether the evaluation of the proposed SEOS impacted the overall rating for scientific implementation merit and feasibility. Lack of an SEO will have no impact on the proposal's overall rating for scientific implementation merit and feasibility.



# Step 1 Science Panel Evaluation Process



## I. Science Panel Composition and Organization:

- The Science Evaluation will be accomplished via one Science Panel; however the effort may flow through sub panels depending on the actual number and variety of proposed science investigations.
- Any sub panel will normally be chaired by a NASA HQ Civil Servant. There will be a co-chair from the scientific community. The composition of the Science Panel Evaluation Members will be dictated by the science evaluation required for the proposals that are submitted.
- Any sub panel will have an Executive Secretary.
- Each proposal will be reviewed by 3-4 members of the panel.
  - The Chief Reviewer for each proposal will lead the discussion.
  - The Executive Secretary will take notes on the discussion.
- External/Mail-In Reviewers (if required for special science expertise) may be utilized by the Science Panel to assist with one or more proposals.
- The TMC Panel will provide instrument technologist support for the Science Panel.



# Step 1 Science Evaluation--II



## II. Science Panel Procedure (continued):

- The Panel may reconsider evaluations, if warranted, at the Plenary.
- Ratings are normalized across all Proposals during the Plenary in order to assure that results are appropriate and fair.
- For each proposal, the process results in
  - o A Scientific Merit adjectival rating.
  - o A Scientific Implementation Merit and Feasibility of the Proposed Investigation adjectival rating.
  - o Supporting documentation for these results is also provided.

## III. Proprietary Information

- All Proposal Materials will be considered Proprietary, and this material will be handled and stored according to NASA policies and procedure for the treatment of Proprietary information.
- Only those with a need to know will be allowed to view Proposal materials.
- SMD Conflict of Interest (CoI) policies will be followed.



# Conclusion



**NASA looks forward to a number of competitive Science Investigations submitted to the the New Frontiers-3 call.**



## Contact information

Thomas Morgan

[thomas.h.morgan@nasa.gov](mailto:thomas.h.morgan@nasa.gov)

202-358-0828

Fax: 202-358-3097